



Strategic Planning Process Building and Fire Research Laboratory



for

**Visiting Committee for Advanced
Technology**

March 7, 2006

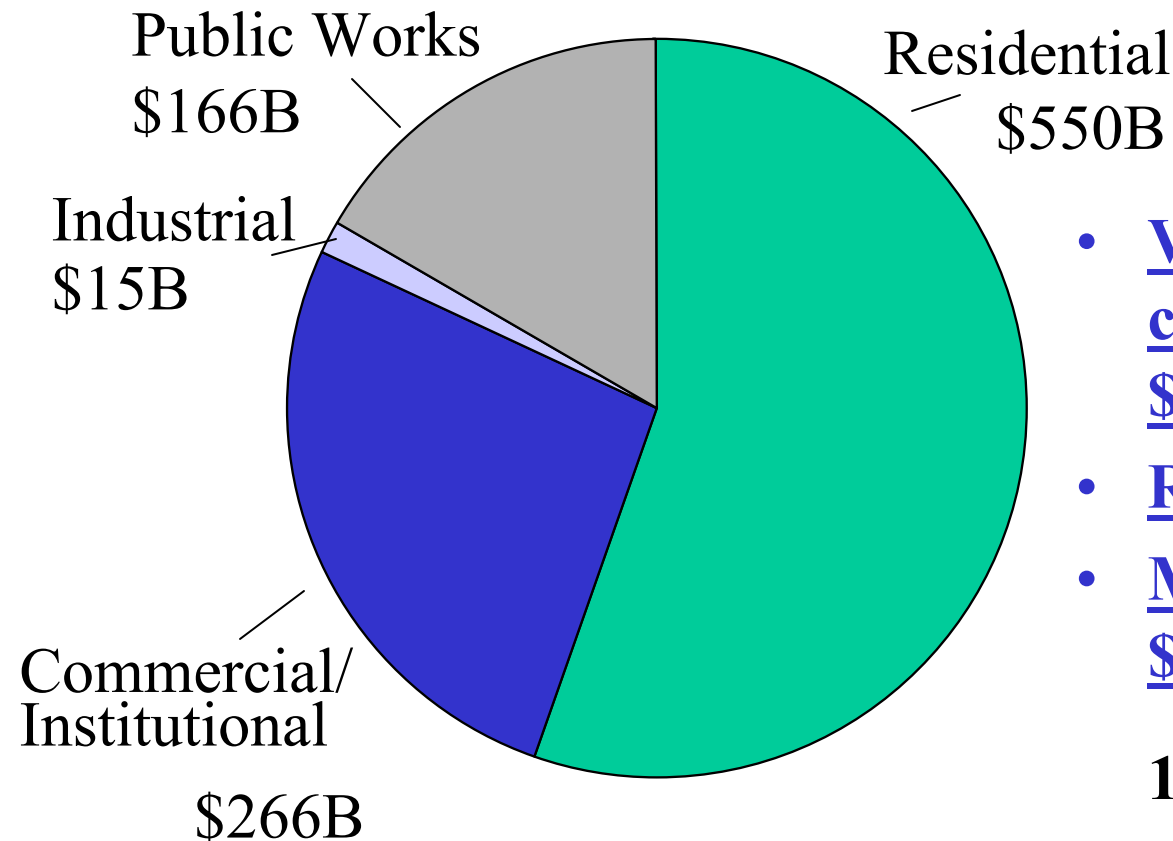


Outline

- **Context for Planning**
 - **Industries We Serve**
 - **BFRL Resources**
- **Planning Process**
- **Current Programs**

Construction and Buildings Annual Costs

\$1.4 Trillion Domestic, \$3.2 Trillion Global



- Value of new construction put in place
\$998B
- Renovation \$202B
- Maintenance & Repair
\$180B

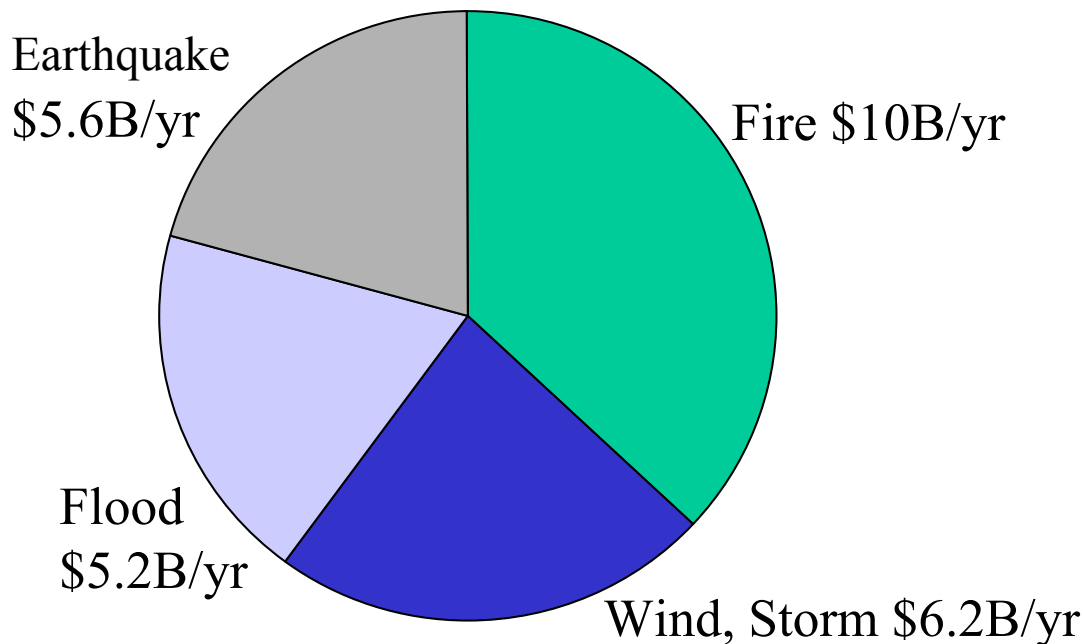
121 million homes

2004 data

Fire and Natural Disasters

Annual Costs

Average Property/Insured Loss



- Fire costs U.S. Economy \$219B/yr

Fire Deaths 3,900

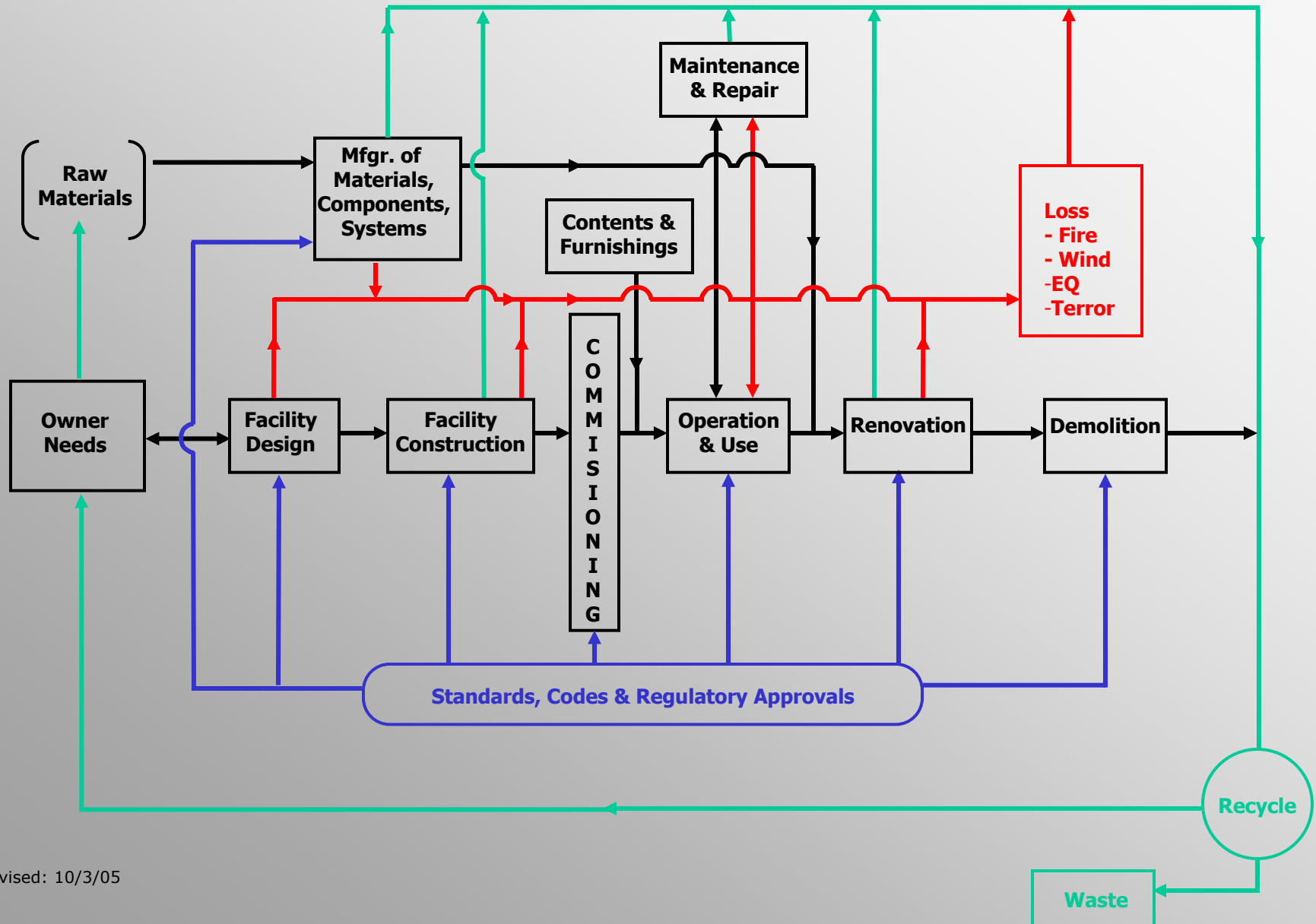
Injuries

Civilian 17,785

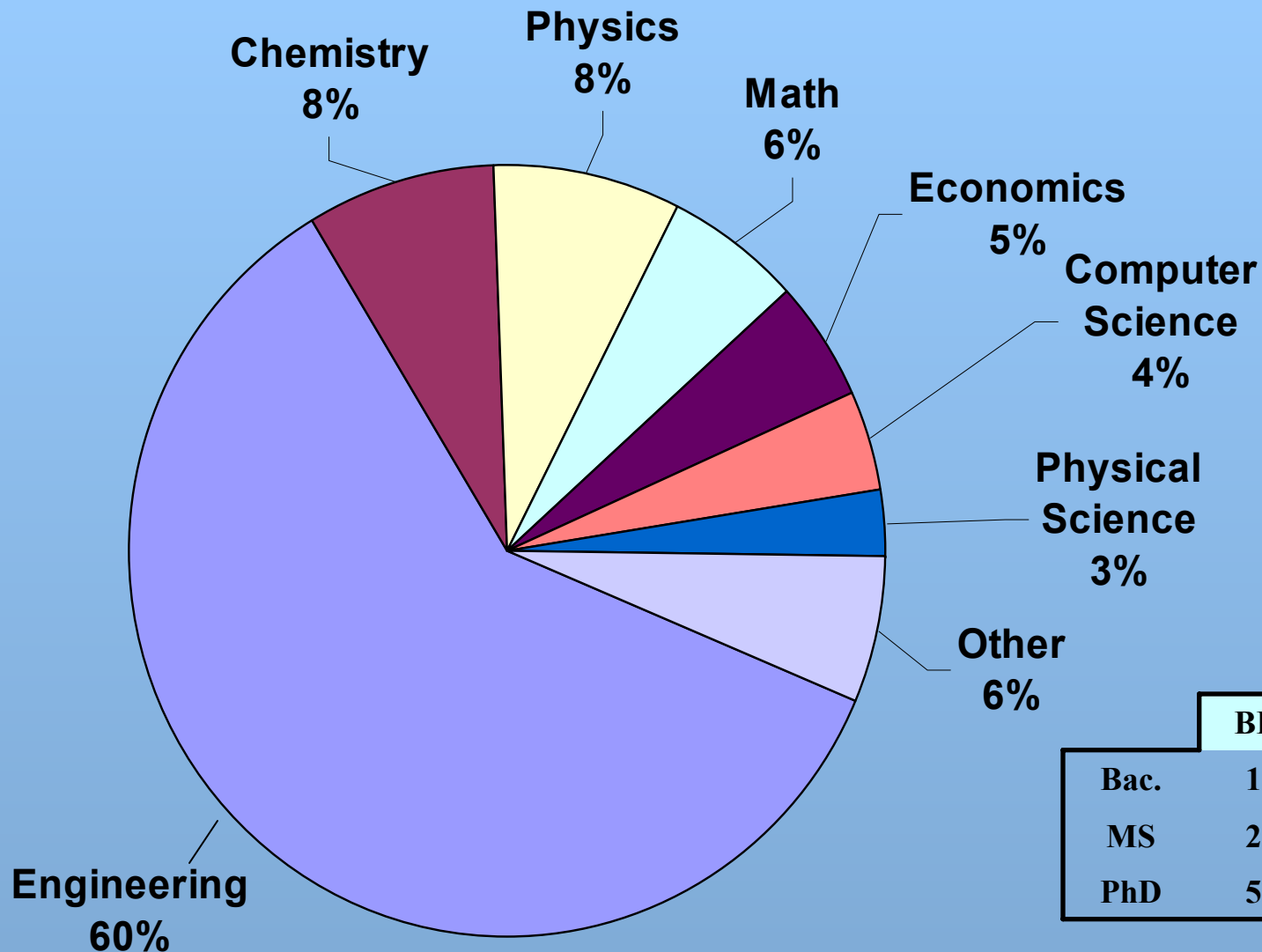
FireFighters 78,750

Single event could be as much as \$80-\$200B

Life Cycle of Constructed Facilities



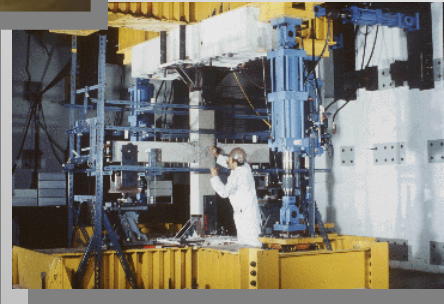
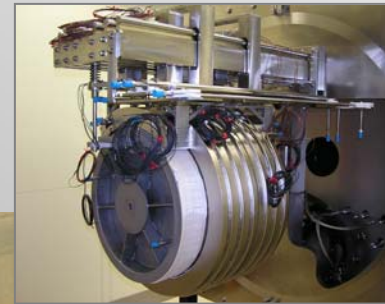
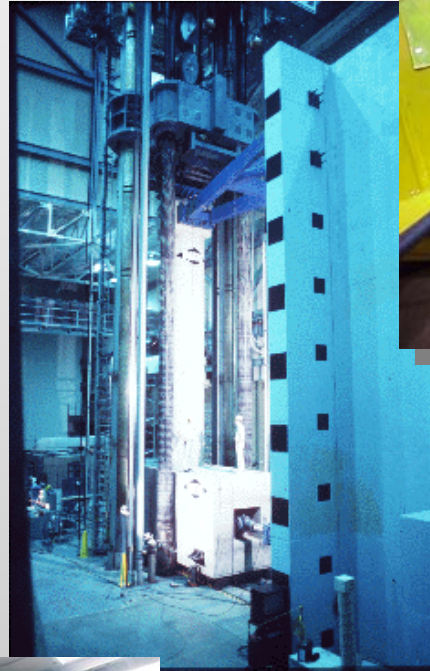
BFRL Professional Staff



	BFRL	NIST
Bac.	18%	30%
MS	26%	25%
PhD	56%	45%

BFRL FACILITIES

- Building Integrated Photovoltaic Testbed
- Mobile Solar Tracker Facility
- High Temperature Guarded Hot Plate
- Tri-directional Test Facility
- Large-Scale Structures Testing Laboratory
- Fire Emulator/Detector Evaluator
- Large Fire Research Facility
- Virtual Cement and Concrete Test Laboratory
- Integrating Sphere UV Exposure Chamber
- Virtual Cybernetic Building Test Bed
- Well Stirred Reactor / Plug Flow Reactor
- Residential Indoor Air Quality Test Laboratory
- Residential Fuel Cell Testing Laboratory
- High-Throughput Research
- Cone Calorimeter



BFRL Mission

Meet the measurement and standards needs of the Building and Fire Safety Communities.

Vision

The source of critical tools -- metrics, models, and knowledge -- *used* to modernize the Building and Fire Safety Communities.

Program and Project Selection

- **Consideration of Drivers/Barriers for Our Industries**
- **Needs of Customers**
 - Direct contacts
 - Workshops
 - Roadmaps
- **Results of Economic Impact Studies**
- **Annual Criteria-Based Selection and Budgeting**
 - Fit to NIST Mission and Technical Challenge
 - Potential Impact and Probability of Success
 - Potential for Outside Funding
- **Additional Considerations**
 - Competence Development/Exploratory Research

Key Drivers/Barriers for Buildings and Fire Communities

- **Sustainability and Environmental Resource Management**
- **Homeland Security**
- **IT, e-Construction**
- **Fragmentation**
- **Stagnant Productivity**
- **Globalization**
- **Demand for “Better, Faster, Less Costly”**
- **“Minimum First Cost” Mindset**
- **Traditional Prescriptive Standards and Codes**
- **Lack of Research**

Customers, Stakeholders, and Partners

Construction Industry

CII, IAI, CERF,
FIATECH, NIBS, AGC,...

Fire and Emergency Service

IAFC, NASFM,
IAFF, FDNY, NYPD,...

Federal Agencies

FEMA, ATF, FBI, DOD,
USACE, DOE, DTRA, NIOSH,
CDC, GSA, State, NSTB, NRC,
IRC/NRCC,...

Public/Groups

Skyscraper Safety,..
Occupants/Witnesses,
Entrepreneurs/Inventors,
Small Businesses,
Students,...

Universities

MIT, Princeton,
Northwestern, UT
Austin, Georgia
Tech, Penn State,
Drexel, Wharton,
Columbia, Lehigh,
UMD, WPI,...

WTC

Public-Private
Response Plan

Codes and Standards

ASCE, AISC, ACI, ICC,
NFPA, ASHRAE,
ASTM, ANSI, ISO,
ASME, NCSBCS,...

Structural Engineering and Design

AIA, Council on Tall
Buildings and Urban
Habitat, SEAoNY, TMS,
NCSEA, CASE,
NYC/DDC, NYNJ Port
Authority,...

Fire Safety Engineering

Private
Consultants,
SFPE,...

Testing

Laboratories
UL, FM Global,
SWRI, IRI,...

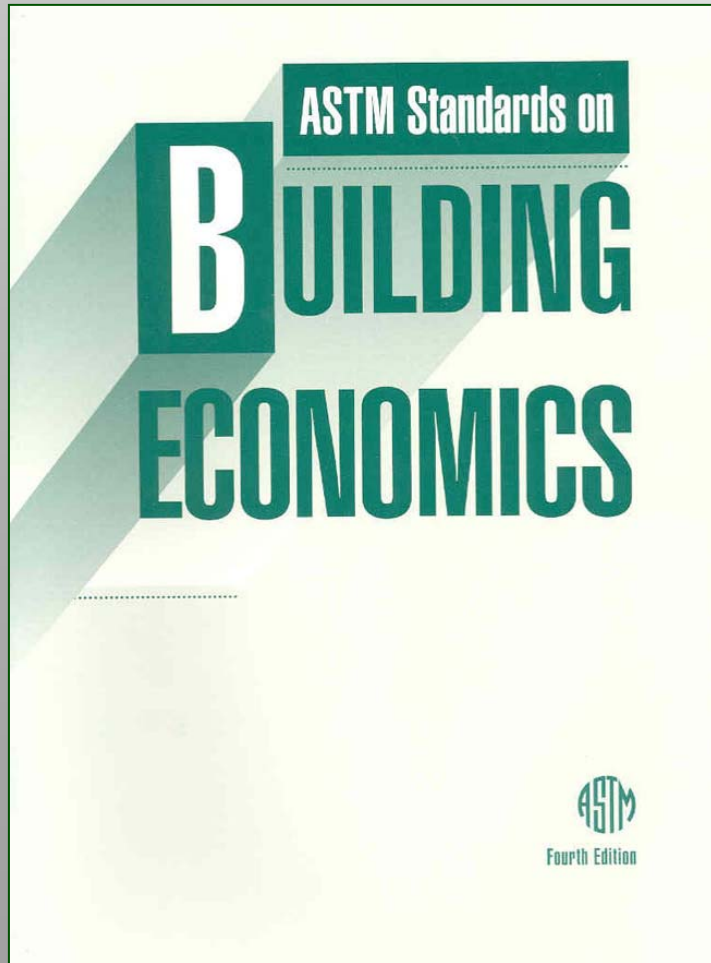
Industry Suppliers

W.R. Grace,
United Technologies,...

BFRL Role in Economic Analysis

- **Identify and develop needed methods**
- **Promulgate methods through ASTM standards**
- **Facilitate use of methods through software development**
- **Illustrate use of methods through case study applications**
- **Use methods to conduct impact studies**

Delivering Methods through ASTM Standards



- **E06.81 Building Economics**
- **20 Standards: Practices & Guides**
- **Selected Standards**
 - ✓ **E 917 Life-Cycle Costs**
 - ✓ **E 1074 Net Savings**
 - ✓ **E 964 Savings-to-Investment Ratio**
 - ✓ **E 1057 Internal Rate of Return**
 - ✓ **E 2204 Guide on How to Summarize Economic Impacts**

Application of BFRL's Economic Evaluation Methods

- **Evaluate new technology**
 - **BridgeLCC**
 - **Fire Sprinklers**
 - **Reduced-Size Venting**
- **Advance national goals at minimum life-cycle cost**
 - **Energy Conservation (BLCC 5.0)**
 - **Environmentally Friendly (BEES 3.0)**
 - **Homeland Security (CET 1.0)**
- **Measure impact of proposed research**
 - **Impact Studies (FSES, CBS, CONSIAT)**

A Few Historical Contributions

- **Fire hose coupling standards**
- **First model zoning ordinance**
- **Fire resistance tests, time temperature curve, ASTM E119**
- **Calculation of compounds in Portland Cement, R.H. Bogue**
- **From 2x6's to 2x4's in the 1940's**
- **Performance concept for standards and codes**
- **Disaster investigations; San Fernando Earthquake, Kansas City Skywalk, Northridge Earthquake, WTC, ...**
- **HUD's Operation Breakthrough**
- **ASHRAE Standard 90: Energy Conservation in Buildings**
- **Flammable fabrics**
- **Residential smoke detectors, UL 217**
- **Guarded hot plate for thermal insulation**
- **Fire Safety Evaluation Systems in NFPA Life Safety Code**
- **BACnet standard for open systems integration of building systems**
- **Creation of FIATECH, Capitol Projects Technology Roadmap**

Key Drivers/Barriers for Buildings and Fire Communities BFRL Response

Drivers/Barriers

**Sustainability and Environmental
Resource Management**

Homeland Security

IT, e-Construction

Fragmentation

Stagnant Productivity

Globalization

Demand for “Better, Faster, Less Costly”

“Minimum First Cost” Mindset

**Traditional Prescriptive Standards and
Codes**

Lack of Research

BFRL Response

Healthy and Sustainable Buildings

Safety of Threatened Buildings

**Construction Integration and Automation,
Cybernetic Building Systems**



**Significant participation in international
standards and related organizations**

Focus of all programs

Pioneer/leader for life cycle costing

**Leading the revolution towards
performance standards in Fire and
Materials programs**

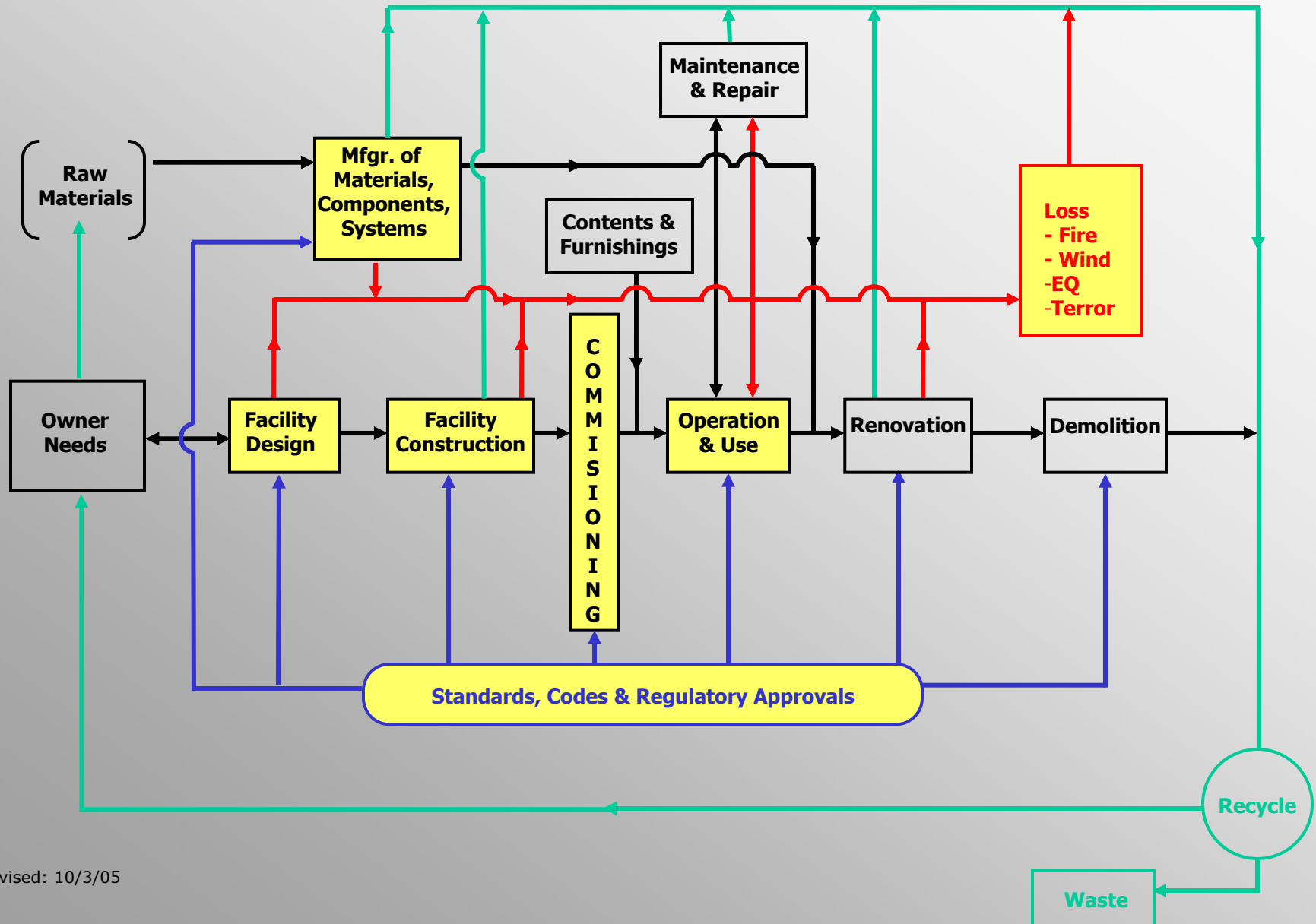
**Research is the foundation of the programs,
Fire Grant Program**

BFRL Programs

FY 2006 STRS Investments, \$M

Prediction and Optimization of Concrete Performance	\$ 1.4
Service Life Prediction of Polymeric Materials	\$ 1.8
Construction Integration and Automation	\$ 1.3
Cybernetic Buildings	\$ 1.4
Healthy and Sustainable Buildings	\$ 3.0
Fire Loss Reduction	\$ 7.9
Safety of Threatened Buildings	<u>\$ 5.1</u>
	\$21.9

Life Cycle of Constructed Facilities



Focus of BFRL Programs

Concrete Performance	Materials science understanding and performance prediction to transform industry to performance standards
Polymer Performance	Reliability-based methodology/laboratory evaluation to replace field exposure as a basis for predicting intended service life
Integration Construction and Automation	Improve supply chain management, capture construction site metrology data for project management, automate construction processes
Cybernetic Buildings	Integrate all building services: energy management, fire, security, transportation, fault detection, diagnostics, control, real time purchase of electricity
Healthy and Sustainable Buildings	Reduce greenhouse gas emissions, provide basis for evaluating “greenness,” mitigate poor indoor air quality
Fire Loss Reduction	Fundamental fire understanding and performance prediction to transform industry to performance standards, reduce residential fire losses associated with flashover, mitigate spread of wildland fires at Wildland-Urban Interface, increase effectiveness and safety of fire fighters
Safety of Threatened Buildings	Improve building and fire codes, standards, and practices to mitigate threats from terrorist attacks (structural integrity, fire resistance, emergency egress, building emergency equipment)